71-3

Highway Safety Literature

An Announcement of Recent Acquisitions. . .

HSL No. 71-3
January 22, 1971

THIS ISSUE CONTAINS:
HS-008 416 - HS-008 435
HS-800 320

U.S. Department of Transportation / National Highway Traffic Safety Administration

HSL No. 71-3 January 22, 1971 HS-008 416 - HS-008 435, HS-800 320

HIGHWAY SAFETY LITERATURE
AN ANNOUNCEMENT OF RECENT ACQUISITIONS

Published Weekly by the National Highway Traffic Safety Administration
Washington, D.C. 20591

INTRODUCTION

Publications announced in *Highway Safety Literature* include the most recent additions to the collection of the NHTSA Scientific & Technical Information Service. Subject areas covered include all phases of highway, motor vehicle, and traffic safety, especially those encompassed by the National Traffic and Motor Vehicle Safety Act of 1966 and the Highway Safety Act of 1966.

Individual issues of *HSL* are numbered according to the year and the issue number within that year; thus, 71 designates the year and 1, 2, 3, etc. the individual issues. To aid the user in location citations by the HS-number, the cover bears the inclusive entry numbers for each issue.

Entries in *HSL* are arranged according to the revised NHTSA Subject Category List shown in the Table of Contents. The List is a two-level arrangement consisting of five major subject fields subdivided into 58 subject groups. Documents related directly to the National Highway Traffic Safety Administration (NHTSA) are announced in a separate section headed NHTSA DOCUMENTS and are numbered in five distinct series: NHTSA Accident Investigation Reports (HS-600 000 series), NHTSA Compliance Test Reports (HS-610 000 series), NHTSA Contractors Reports (HS-800 000 series), NHTSA Staff Speeches, Papers, etc. (HS-810 000 series), and NHTSA Imprints (HS-820 000 series). For NHTSA DOCUMENTS in series HS-600 000 and HS-610 000, individual full case reports are available for inspection at the National Highway Traffic Safety Administration; or for purchase from NTIS (see page ii). Although announced together in a separate section, these documents are also assigned specific subject categories for machine retrieval.

A document which contains a number of separate articles is announced as a complete volume in the subject category most applicable to it as a whole. Entries for the individual articles appear in their most specific subject category.

SAMPLE ENTRIES

Subject Category Array

NHTSA Accession no..... HS-800 218 Fld. 5/21; 5/9

Title of document..... AN INVESTIGATION OF USED CAR SAFETY STANDARDS--SAFETY INDEX: FINAL REPORT. VOL. 6 - APPENDICES G-L

Personal author(s)..... by E. N. Wells; J. P. Fitzmaurice; C. E. Guilliams; S. R. Kalin; P. D. Williams

Corporate author..... Operations Research, Inc., Silver Spring, Md., O15000 ← For computer use only

Collation

Publication date..... 12 Sep 1969 150p
Contract FH-11-6921
Report no. ORI-TR-553-Vol-6; PB-190 523

Abstract..... Appendices G-L to this study of used car safety standards include: indenture model diagrams for classes I-IV motor trucks; degradation, wear, and failure data for motor truck classes I-IV; and safety index tables for classes I-IV motor trucks.

Search terms: Wear /Trucks; Failures /Trucks; Used cars; Inspection standards /Trucks; Inspection standards /Data

HS-004 497 Fld. 5/19

AUTO THEFT–THE PROBLEM AND THE CHALLENGE

by Thomas A. Williams, Sr.

Journal citation . . . Published in *FBI Law Enforcement Bulletin* v37 n12 p15-7 (Dec 1968)

Gives figures on the extent of the auto theft problem and comments on antitheft devices available now or in the planning stage.

Search terms: Theft, Theft protection, Stolen cars

TABLE OF CONTENTS

NOTE: ( ) Numbers in parentheses following certain subject groups indicate the Highway Safety Program Standards (No. 1, and up) and/or Federal Motor Vehicle Safety Standards (No. 101 and up) which may apply to these groups.

NHTSA SUBJECT FIELDS AND GROUPS

NOTE: Material published in Highway Safety Literature (HSL) is intended for the information and assistance of the motor vehicle and highway safety community. While brands names, equipment model names and identification, and companies may be mentioned from time to time, this data is included as an information service. Inclusion of this information in the HSL should not, under any circumstances, be construed as an endorsement or an approval by the National Highway Traffic Safety Administration, Department of Transportation of any particular product, course, or equipment.

Harry A. Feinberg
Managing Editor

AVAILABILITY OF DOCUMENTS
AND
INSTRUCTIONS FOR ORDERING

Department of Transportation personnel may borrow copies of publications directly from the NHTSA. Outside the Washington, D.C. area, phone (202) 426-2768. In Washington, D.C. area, use government ID, phone 118-62768. Non-DOT personnel should contact their company or agency libraries for assistance.

Journals cited may be obtained through most research libraries.

Contractors' reports and other documents can usually be obtained as indicated under AVAILABILITY. However, there is no certainty that retention copies will be available for more than a limited period after a document is issued.

The more common distribution sources are identified by symbols which are explained below:

NTIS: National Technical Information Service (formerly Clearinghouse for Federal Scientific and Technical Information–CFSTI), Springfield, Va. 22151. *Order by accession number: HS, AD, or PB.* Prepayment is required by NTIS (CFSTI) coupon (GPO coupons are not acceptable), check, or money order (made payable to the NTIS). *HC* (Paper copy; full size original or reduced facsimile) $3.00 up; *MF* (microfiche approximately 4x6" negative sheet film; reader required) $0.95.

GPO: Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Give corporate author, title, personal author, and report number. Prepayment is required by GPO coupon (NTIS [CFSTI] coupons are not acceptable), check or money order (made payable to the Superintendent of Documents).

HRB: Highway Research Board, National Academy of Sciences, 2101 Constitution Ave., N. W., Washington, D C. 20418.

NHTSA: National Highway Traffic Safety Administration General Services Division, Washington, D.C. 20591 (Telephone (202) 426-0874).

SAE: Society of Automotive Engineers, Dept. HSL, 2 Pennsylvania Plaza, New York, N.Y. 10001. Order by SAE report number. Prices given are list; discounts are available to members and sometimes to libraries and U.S. Government Agencies. Prepayment is required; orders without payment are subject to a $1 handling charge.

IMPORTANT

WHEN REQUESTING a document, to be absolutely sure you receive what you order, give the accession number (HS, PB, AD number) or report number (in cases such as an SAE document), title of report, and the personal or corporate author (whichever is cited). When requesting an HS-numbered document from NTIS (CFSTI), add DOT/ to the prefix HS-; example HS-800 000 should be ordered as DOT/HS-800 000.

SPECIAL NOTICE

NEW PRICES FOR DOCUMENTS AVAILABLE FROM NTIS

On January 1, 1971, the National Technical Information Service (NTIS) increased the prices for documents in certain categories. These increases were made necessary by increased costs. Prices are now as follows:

PAPER COPY

Most documents announced after January 1, 1969, are priced:

1 to 300 pages	$3.00
301 to 600 pages	6.00
601 to 900 pages	9.00
Over 900 pages	Exception Price

Two years after announcement, documents having 300 pages or less will have a service charge of $3.00 added to the announced price. No service charge will be added for documents over 300 pages.

Documents announced prior to January 1, 1969, have a service charge of $3.00 added to the announced price.

MICROFICHE

Microfiche reproduction of documents on a demand basis are priced at 95 cents per document.

Documents available on Standing Order through NTIS Selective Dissemination of Microfiche Service (SDM) are priced at 35 cents per document.

1/0 ACCIDENTS

1/3 Investigation and Records

HS-008 416 Fld. 1/3; 3/9

AN EVALUATION OF THE HAZARD CREATED BY NATURAL DEATH AT THE WHEEL

by Susan P. Baker; Werner U. Spitz

Published in *New England Journal of Medicine* v283 n8 p405-9 (20 Aug 1970)

13 refs

Assessment of the hazard associated with sudden natural death of drivers suggests that the magnitude of the problem does not warrant costly and restrictive control efforts. Investigation of 591 collisions that caused fatal injuries to drivers or pedestrians revealed that none of them resulted from natural death at the wheel. Natural death of a sober driver apparently does not entail measurable risk of death or severe injury to his passengers or other persons. Collisions caused by these deaths are relatively infrequent, representing less than 6 per 10,000 motor-vehicle collisions. Nonfatal medical impairments still need to be explored more precisely before driver examinations and restrictions can be considered justified and effective.

Search terms: Natural deaths / Accident causes; Collisions /Fatalities; Statistics /Natural deaths; Statistics /Collisions; Statistics / Fatalities; Cardiovascular diseases / Driver fatalities

2/0 HIGHWAY SAFETY

2/4 Design and Construction

HS-008 417 Fld. 2/4; 5/4

APPLICATION OF VEHICLE OPERATING CHARACTERISTICS TO GEOMETRIC DESIGN AND TRAFFIC OPERATIONS. FINAL REPORT

by Morton I. Weinberg; Harvey Goldstein; Richard A. Raub; Kenneth J. Tharp; Kenneth Perchonok

Cornell Aeronautical Lab., Inc., Buffalo, N. Y., C67200

Feb 1967 175p 28 refs
Contract HR-3-10
Report no. CAL-VJ-2222-V-1

Information has been compiled for agencies responsible for highway design and traffic operations in revising standards and procedures. Five nationally used reference books on highway design and traffic operations and three state highway manuals were reviewed to determine whether changes were needed because of changing vehicle design or performance capabilities. No changes in standards or procedures appeared to be necessary because of vehicle changes. Recommendations are made for the establishment of new standards and for review of existing ones because of increased knowledge concerning the relationship of the vehicle to the highway and to traffic operations. Statistically derived probabilities of occurrences are the foundations for other recommendations.

Search terms: Highway design / Traffic administration; Manuals / Highway design; Manuals /Traffic administration; Motor vehicle characteristics; Highway standards; Motor vehicle design; Man machine systems; Statistical analysis /Highway design

2/9 Traffic Control

HS-008 418 Fld. 2/9

DO WE REALLY WANT TO STOP TRAFFIC JAMS?

by Arthur F. Underwood

General Motors Research Labs., Warren, Mich., G10800

1970 4p
Report no. SAE-700188

Presented at Automotive Engineering Congress, Detroit, Mich., 12-16 Jan 1970.

Traffic flow can be improved at relatively low cost by utilizing knowledge which already exists. Procedures discussed to reduce traffic jams and improve motoring safety are: platoon system on expressways based on speed; proceeding through intersections on the amber light; all cars at a traffic light moving simultaneously on the green light; speed above the posted limit permitted for passing; right turns permitted on red light after stop; support for citizens radio service; temporary bridges to relieve traffic jams at crowded intersections; and fringe parking. Too much time and effort is being spent on 5% of the motorist's problems, rather than working on solutions for 95% of his problems.

Search terms: Traffic flow /Vehicle platoons; Speed /Vehicle platoons; Traffic signals /Traffic flow; Passing /Traffic flow; Radio communication /Traffic flow; Overpasses /Traffic flow; Fringe parking /Traffic flow; Uniform vehicle code /Traffic flow

AVAILABILITY: SAE

3/0 HUMAN FACTORS

3/1 Alcohol

HS-008 419 Fld. 3/1

ESTIMATING THE EFFECTIVENESS OF BLOOD ALCOHOL LIMITS

by Paul M. Hurst

Published in *Behavioral Research in Highway Safety* v1 n2 p87-99 (Summer 1970)

11 refs
Grant MH-11294

The belief that crash probability is a strongly accelerated function of blood alcohol concentration (BAC) was confirmed by the analysis of relative hazard. The average relative hazard curve tended to be less steep in localities where there were more drinking drivers, a possible adaptation to driving in the low-to-moderate BAC range. The belief is confirmed that alcohol plays a greater role in the more severe crashes, but this obtains only at very high BAC. This implies the existence of two casual mechanisms: one operating over the entire alcohol range to increase crash probability, and a second, operating only at high BAC, to increase crash severity. It was tentatively concluded that greater emphasis

3/1 Alcohol (Cont'd)

HS-008 419 (Cont'd)

should be given to enforcement than to enacting more stringent BAC limits. The relationship between stringency and enforcement-acceptance should be further investigated, since the saving in crash injuries from reducing a limit might be reversed by even a small decrease in the rigor of its enforcement.

Search terms: Blood alcohol levels /Accident risks; Blood alcohol levels /Accident severity; Bayes theorem /Accident risks; Blood alchool levels /Fatalities; Drinking drivers /Accident risks; Driver intoxication /Accident risks; Drinking drivers /Law enforcement; Law enforcement /Accident prevention; Blood alcohol levels /Law enforcement

3/4 Driver Behavior

HS-008 420 Fld. 3/4

EMOTIONAL STRESS AND DRIVING PERFORMANCE: THE EFFECT OF EMOTIONAL STRESS AND DRIVING PERFORMANCE: THE EFFECT OF DIVORCE

by Lucille McMurray

Published in *Behavioral Research in Highway Safety* v1 n2 p100-14 (Summer 1970)

Driving records of 410 persons involved in divorce proceedings (female and male plaintiffs and defendants) were analyzed to study driving performance under stress. The seven year driving record was poorer than average. During the year of highest stress, higher accident and violation rates occurred in all cases except accidents of male plaintiffs and violations of female defendents. The first three months after filing was the time of greatest accident and violation activity. All groups except male plaintiffs had a higher ratio of accidents to violations that year than for the total seven years. Those who had accidents that year, however, had higher than average violation rates. Types of violations more common than average during stress are speeding, failure to yield, and defective equipment. There was a smaller than average proportion of mandatory license suspension violations during the year of stress.

Search terms: Divorce /Accident factors; Divorce /Driver records; Driver performance /Divorce; Sex factors in driving /Divorce; Sex factors in accidents /Divorce; Stress (psychology) /Driver performance; Divorce /Traffic violations; Driver performance /Statistics; Sex factors in driving /Statistics; Driver license suspension /Divorce

HS-008 421 Fld. 3/4

DRIVERS' JUDGMENTS IN OVERTAKING AND PASSING

by Donald A. Gordon; Truman M. Mast

Published in *Human Factors* v12 n3 p341-6 (Jun 1970)

6 refs

Drivers' judgments in vehicular overtaking and passing were studied using familiar (drivers' own) cars and an unfamiliar government vehicle at speeds of 18, 30, and 50 mph. Drivers were not able to estimate passing distances accurately. Average errors of estimation for the different conditions varied from 20 to 50% of the actual overtaking distance. Errors of underestimation, where the maneuver required more space than judged, increased with speed. At 18 mph. 15% of the estimates made by drivers were underestimates: at 50 mph 68% were underestimates. There were no differences observed attributable to familiarity with the car.

Search terms: Overtaking /Driver behavior; Passing /Driver behavior; Overtaking /Speed; Passing /Speed; Overtaking /Statistics; Passing / Statistics; Overtaking /Driver performance; Passing /Driver performance; Passing / Judgment

HS-008 422 Fld. 3/4

ADMINISTRATIVE AND RESEARCH PROBLEMS IN IDENTIFYING INDIVIDUALS WITH HIGH CRASH RISK

by Julian A. Waller

Published in *Behavioral Research in Highway Safety* v1 n2 p67-77 (Summer 1970)

15 refs

Presented at Southeastern Psychological Assoc. Annual Meeting, New Orleans, La., 27 Feb 1969.

For administrative purposes, it is relatively easy to identify groups with high crash risk, but difficult to distinguish individuals with high crash risk. In order for research to have administrative value, it must indicate whether methods used to identify high risk drivers are screening or diagnostic devices, and what proportions of false negatives and false positives can be expected. The behavior of some readily identifiable high risk drivers cannot be easily modified. Therefore, it often is more appropriate to change the environment or to reduce the likelihood of injury in crashes than to try to change driver behavior.

Search terms: Accident risks / Driver behavior; High risk drivers / Accident proneness; High risk drivers /Administration; High risk drivers /Attitudes; High risk drivers /Adolescent drivers; High risk drivers /Young adult drivers; High risk drivers /Drinking drivers; High risk drivers /Sociological factors; High risk drivers /Handicapped drivers; High risk drivers /Research

HS-008 423 Fld. 3/4

ATTITUDES TOWARD DRIVING SAFETY AND THEIR MODIFICATION

by D. H. Schuster

Published in *Human Factors* v12 n1 p89-94 (Feb 1970)

22 refs

Based on a paper presented at 12th Annual Meeting of the Human Factors Society, Chicago, Ill., Oct 1968.

The measurement of attitudes toward traffic safety and the attempts to change these attitudes and related driving behavior are reviewed and discussed. Psychological testing of such attitudes and personality characteristics is fairly well developed and there

are some instruments of good reliability and useable validity. Efforts to modify driver attitudes and behavior are inconclusive and only mildly encouraging. Considerable research needs to be done before the attitudes and behavior of drivers can be changed to improve traffic safety in the United States.

Search terms: Driver attitudes / Highway safety; Driver attitude measurement; Driver education / Psychological factors; Driver behavior /Driver improvement; Driver attitudes /Driver improvement

HS-008 424 Fld. 3/4

A FACTOR ANALYTIC APPROACH TO THE DRIVING TASK

by Vernon S. Ellingstad

Published in *Behavioral Research in Highway Safety* v1 n2 p115-26 (Summer 1970)

Contract PH-86-68-155 Grant UI-01001

Psychomotor performance data were collected from 80 subjects who drove the HSR Car, and 56 who were tested on the Sim-L-Car point light source driving simulator. Six steering and speed control variables were represented in the HSR Car battery, while nine variables were included in the Sim-L-Car battery. Data from each battery were subjected to a principal axis factor analysis which employed an orthogonal rotation as a final step. Results indicated that the test space of the HSR Car battery was defined by three orthogonal dimensions representing steering control, speed control, and operator input variability. For the Sim-L-Car four dimensions were extracted by the analysis. These involved steering control, tracking error production, speed control, and operator input variability.

Search terms: Driving tasks /Steering; Driving simulators /Sim L Car; Driving simulation; Driving tasks / Speed control; Driving tasks /Measuring instruments; Measuring instruments /Highway Systems Research Car; Driving tasks /Tracking; Driver performance

4/0 OTHER SAFETY–RELATED AREAS

4/2 Community Support

HS-008 425 Fld. 4/2

TOWARD A SAFER TOMORROW

by Robert P. Miskelly

Published in *Analogy* n9 p21-3 (1970)

The Allstate Insurance Companies' campaign to reduce traffic fatalities is described. This campaign used advertising in daily papers and national magazines, pamphlets, a discount insurance plan for trained young drivers, a scholarship program for high school driver education instructors, a driving simulation program, TV programs and advertising, and special meetings and professional conferences to present its message. The drunk driver crash reduction program has first priority in this campaign.

Search terms: Safety campaigns / Allstate Insurance Companies; Safety campaigns /Mass media; Safety campaigns /Driver education; Safety campaigns /Driving simulation; Safety campaigns /Driver intoxication; Safety campaigns / Conferences

HS-008 426 Fld. 4/2

PLANNING TECHNIQUES FOR THE EVALUATION OF COMMUNITY SUPPORT EFFICIENCY IN SAFETY

by Thomas W. Planek

Published in *Human Factors* v12 n1 p47-54 (Feb 1970)

26 refs

Based on a paper presented at the 12th Annual Meeting of the Human Factors Society, Chicago, Ill., Oct 1968.

Community support is defined and a brief description of the background of support development is presented. Evaluation of safety programs in terms of compliance to national standards only is questioned. It is recommended that a program's relation to the state or local accident problem be the focus of evaluation. The planning problems associated with community support are analyzed. Techniques for solving these problems are recommended. Political and communication problems reducing support efficiency are analyzed and solutions suggested. An approach to the evaluation of action programs combining both practical and scientific considerations is presented.

Search terms: Community support /Safety programs; Safety standards /Compliance; Accident prevention /Community support; State government /Safety programs; Mass media /Safety programs

5/0 VEHICLE SAFETY

HS-008 427 Fld. 5/0

RECENT TRENDS IN VEHICLE USE IN THE UNITED STATES AND IN BRITAIN

by A. H. Tulpule

England. Road Research Lab., Crowthorne, Berks., E14400

1970 25p 19 refs
Report no. RRL-LR-354; PB-195 348

Data for vehicle kilometers traveled in the United States in 1962 and 1967 are analyzed. Kilometers per vehicle tend to be slightly lower in states which have high levels of vehicle ownership, as are the growth rates of kilometers per vehicle in states with high growth rates of vehicle ownership. Changes in kilometers per vehicle also depend on rate of growth of income. Similar data for Britain for 1960 and 1966 show tendencies similar to those observed in the United States, but the relationships are less marked. Some factors that would explain the lower levels of kilometers per vehicle in Britain than in the United States are discussed. These differences may partly be due to higher population densities, lower levels of capital investment in the road system, and higher real running costs of vehicles in Britain.

Search terms: Vehicle mileage / Statistics; Vehicle mileage /Great Britain; Vehicle mileage /United

5/0 VEHICLE SAFETY (Cont'd)

HS-008 427 (Cont'd)

States; Population density /Vehicle mileage; Vehicle operating costs / Vehicle mileage; Highway costs / Vehicle mileage

AVAILABILITY: NTIS

HS-008 428 Fld. 5/0

SAE TRANSACTIONS AND LITERATURE DEVELOPED DURING 1969. INDEX-ABSTRACTS, VOL. 78

Society of Automotive Engineers, Inc., New York, S21600

1970 279 refs

This annual volume contains: a list of the personnel which control the information output of the Society; a list of papers presented at national meetings and conferences, by meeting name arranged chronologically; winners of awards; a list of papers designated as the Society's transactions, arranged by author; abstracts of each piece of literature issued by the Society, arranged by code number; a subject index; an author index; and a cross reference of code numbers to volumes of proceedings or special publications.

Search terms: Society of Automotive Engineers /Bibliographies; Motor vehicle design /Bibliographies; Society of Automotive Engineers / Personnel; Society of Automotive Engineers /Awards; Automotive engineering /Conferences

AVAILABILITY: SAE

5/4 Design

HS-008 429 Fld. 5/4

FUNDAMENTAL PARAMETERS OF VEHICLE FUEL ECONOMY AND ACCELERATION

by David N. Hwang

Ford Motor Co., Dearborn, Mich., F18600

1969 16p 31 refs
Report no. SAE-690541

Presented at SAE Detroit Section Meeting, Detroit, Mich., 30 Oct 1968.

The selection of an optimum power train package for a given vehicle model to meet manufacturer's performance criteria and customers' desires is usually achieved through a series of compromises between the parameters affecting fuel economy and acceleration. This process can be aided by computer simulation methods. The computer simulation technique discussed can accept some fundamental parameters directly and others indirectly since they are expressed as equations or input tables. Computer results are calculated in terms of performance criteria. Thereby the effect of fundamental parameter on fuel economy and acceleration can be realistically analyzed and individually compared. Proving ground assessment of the actual vehicle, however, remains the final validation.

Search terms: Motor vehicle design /Fuel consumption; Motor vehicle design /Acceleration; Fuel consumption /Parameters; Acceleration /Parameters; Transmissions / Parameters; Mathematical models / Motor vehicle design; Computerized simulation /Motor vehicle performance; Torque /Parameters; Axles / Parameters

AVAILABILITY: SAE

5/7 Glazing Materials

HS-008 430 Fld. 5/7

WINDSHIELD SEALING PARAMETERS

by Ronald R. Parry

American Motors Corp., Detroit, Mich., A35400

1970 8p 5 refs
Report no. SAE-700098

Presented at Automotive Engineering Congress, Detroit, Mich., 12-16 Jan 1970.

Windshield sealing materials, related parts, and the process concept are all principle factors in determining what will be used to fill the void between the windshield glass and body opening. Design must provide for clearance between glass and metal, adequate glass and metal overlap allowance, sufficient bonding area between glass and metal, and windshield retention to the body to conform to Federal regulations. Extruded rubber gaskets, preformed butyl seals, and pumpable type sealants are discussed. The process of windshield sealing and attachment is described and illustrated. Four future trends are given.

Search terms: Windshield design; Windshield mounting /Seals; Glass/ Windshields; Body design /Windshields; Windshields /Safety standards; Windshield mounting /Rubber gaskets

AVAILABILITY: SAE

5/9 Inspection

HS-008 431 Fld. 5/9; 5/20

SELECTED SAFETY ROAD CHECKS, MOTOR CARRIERS OF PROPERTY, FISCAL YEAR 1969

Bureau of Motor Carrier Safety, Washington, D. C., B32400

1969 20p

During the fiscal year ending June 30, 1969, inspections of 49,502 trucks, tractors, and trailers were made. Of these 11,507 or 23.2% were found to be mechanically unsafe for continued operation and were ordered out of service at the point of inspection until essential repairs had been completed. Defects are broken down by type of vehicle, kind of carrier, and defect categories.

Search terms: Sampling /Motor vehicle inspection; Sampling / Defective vehicles; Motor carriers / Defective vehicles; Motor carriers / Motor vehicle inspection; Motor vehicle inspection /Trucks; Motor vehicle inspection /Tractors; Motor vehicle inspection /Trailers; Defective vehicles /Trucks; Defective vehicles /Tractors; Defective vehicles /Trailers

SAFETY BUS CHECKS, MOTOR CARRIERS OF PASSENGERS, YEAR 1969

Bureau of Motor Carrier Safety, Washington, D. C., B32400

Apr 1970 5p

During 1969 inspections were made of 397 buses operated by 107 different interstate motor carriers. Of these buses, 47 or 11.8% were ordered out of service until corrections essential for safe operation had been made. Buses with apparent defects were selected for inspection over those which appeared to have been better maintained, so the sample does not measure the proportion of defective buses on the highway. Types of defects are analyzed.

Search terms: Motor vehicle inspection /Buses; Motor carriers /Motor vehicle inspection; Sampling /Motor vehicle inspection; Sampling / Defective vehicles; Defective vehicles /Buses; Motor carriers /Defective vehicles

5/10 Lighting Systems

HS-008 433 Fld. 5/10

LIGHTING THE ROAD

by Roger Livesey

Published in *Engineering* v208 n5399 p408-409 (17 Oct 1969)

Types of headlamps are discussed, especially the quartz halogen headlamp. Suitability of different headlamps for winter fog conditions, dipping of headlamps, the Autosensa, and the use of auxiliary headlamps are discussed.

Search terms: Headlamps; Quartz halogen headlamps; Winter driving / Headlamps; Autosensa; Low beamed headlamps; Fog /Headlamps

5/18 Steering Control System

HS-008 434 Fld. 5/18; 5/1; 4/7

HIGHWAY VEHICLE STABILITY IN BRAKING MANEUVERS

Peter G. Fielding; Glenn G. Balmer

Booz-Allen Applied Research, Inc., Bethesda, Md., B20400; Bureau of Public Roads, Washington, D. C., B33600

1970 17p 23 refs
Contract FH-11-6859
Report no. SAE-700515

Presented at SAE Mid-Year Meeting, Detroit, Mich., 18-22 May 1970.

Dynamic equations for an automobile in braking maneuvers are simplified in two steps: a nominal rectilinear trajectory is considered, with a constant deceleration rate; and a small perturbation in side-slip angle is examined, and linearized equations of motion are derived. Solutions are obtained in terms of Bessel functions. The response is deemed stable when initial perturbations to the nominal trajectory are damped, and the perturbed motion is oscillatory. Algebraic expressions for the stability criteria are derived, illustrating the effects of speed, road frictions, tire slip ratio, and vehicle design characteristics on vehicle response in braking maneuvers.

Search terms: Vehicle stability / Braking; Equations of motion / Braking; Braking /Sideslip; Vehicle trajectories /Deceleration; Bessel functions /Braking; Speed /Braking; Friction /Braking; Damping /Vibration; Tire slip motion /Braking; Motor vehicle design /Braking; Mathematical models /Braking; Mathematical analysis /Vehicle stability

AVAILABILITY: SAE

5/22 Wheel Systems

HS-008 435 Fld. 5/22

THE EFFECT OF TREAD PATTERN DEPTH ON SKIDDING RESISTANCE

by G. C. Staughton

England. Road Research Lab., Crowthorne, Berks., E14400

1970 23p 7 refs
Report no. RRL-LR-323; PB-195 593

The effect of tread pattern depth on skidding resistance in wet conditions was investigated on six road surfacings rent tread design in various stages of wear. Measurement of locked wheel and peak braking force coefficients were made over a speed range of 50-130 kilometers per hour. Findings were: road surface texture and vehicle speed both interact with the effect of tread pattern depth on wet skidding coefficient; on rougher surfaces, providing adequate drainage, tread depth generally has only a small effect on the braking force coefficient; on smoother surfaces, a more pronounced change occurs in braking force coefficient with tire wear, becoming very marked for tread depths less than 1-2mm; at the higher speeds, on smooth surfaces, even full tread depth gave very little improvement in locked wheel coefficient over a smooth tire.

Search terms: Tire tread depths / Wet skidding; Asphalt pavements / Wet skidding; Concrete pavements / Wet skidding; Macadam pavements / Wet skidding; Speed /Wet skidding; Braking forces /Wet skidding; Wheel locking /Wet skidding

AVAILABILITY: NTIS

NHTSA DOCUMENTS

NHTSA Contractors Reports

HS-800 320 Fld. 1/3

MULTIDISCIPLINARY ACCIDENT INVESTIGATION. FINAL REPORT FOR THE PERIOD 13 JUNE 1969 TO 31 JULY 1970

by J. Robert Cromack; Jimmie L. Wright

Southwest Research Inst., San Antonio, Tex., S31800

1 Aug 1970 131p
Contract FH-11-7219

This *final report* includes *case summaries* 6901, 6903-6906, 6908, 6911-6917, 7003-7009, 7011-7014, 7017-7022.

The objectives, organization, equipment, accident criteria, and investigation procedures for multidisciplinary accident investigation teams are summarized. There were 30 accident cases

NHTSA Contractors Reports (Cont'd)

HS-800 320 (Cont'd)

involving 50 vehicles and 76 occupants investigated. Seven fatalities and 26 non-injuries were recorded. Some accident factors discussed are: tire underinflation, worn tires, poor vehicle maintenance, road defects, weather conditions, sex of driver, driving records, incapacitating factors, alcohol, driver personality factors, and restraint system use. The effectiveness of current standards and motor vehicle inspection are evaluated. Conclusions and recommendations concern: driver education programs; poor-risk drivers; public information; use of alcohol; common accident causes; emergency medical services; side-impact protection; motor vehicle inspection; and roadside obstructions. Individual case summaries are included.

Search terms: Accident investigation /Multidisciplinary teams; Fatalities; Inflation pressure /Accident factors; Tire wear /Accident factors; Motor vehicle maintenance /Accident factors; Defective vehicles / Accident factors; Accident factors / Hazards; Weather /Accident factors; Driver records /Accident factors; Sex factors in accidents; Racial factors /Accident factors; Education /Accident factors; Income / Accident factors; Age factor in accidents; Marital status /Accident factors; Sociological factors /Accident factors; Driver intoxication / Accident factors; Drinking drivers / Accident factors; Fatigue (biology) /Accident factors; Stress (psychology) /Accident factors; Psychological factors /Accident factors; Restraint system use /Accident factors; Seat belt use /Injury severity; Motor vehicle inspection / Accident factors; Case reports; Driver education /Accident prevention; Instrumented vehicles /Accident investigation; Accident investigation /Texas; Motor vehicle registration /Statistics; Fatalities / Statistics; Accident factors /Statistics; Injuries /Statistics; Vehicle age /Statistics; Accident severity / Statistics; Statistics /Hazards; Accident location /Statistics; Defective vehicles /Statistics; Weather /Statistics; Sociological factors /Statistics; Driver records /Statistics; Driver intoxication /Statistics; Fatique (biology /Statistics; Stress (psychology) /Statistics; Psychological factors /Statistics; Restraint system use /Statistics; High risk drivers

AVAILABILITY: NTIS

executive summary

A SYNOPSIS OF A RECENTLY RELEASED NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION RESEARCH REPORT

FULL-SCALE CRASH TESTS OF RIGIT SIMULATED HEAVY VEHICLE UNDERRIDE GUARD–INTERIM TECHNICAL REPORT

The purpose for this contract was to establish and conduct a program of analytical and experimental research to develop bumper and heavy vehicle underride guard configurations to assure intervehicular compatibility and provide effective crash energy control.

Contract No. FH-11-7317
Cornell Aeronautical Lab., Inc.
4455 Genesee Street
Buffalo, New York 14221
DOT/HS-800 316

Total Award Amount: $482,204.00
Interim Report:
Date Report Rec'd: 8/24/70
Release Date: 12/18/70

THE PROGRAM

In the first phase of the experimental program, a series of six full-scale tests of automobiles impacting a rigid simulated heavy vehicle underride guard was completed. The results of those tests are presented in the report. The test vehicles represented three general classes of conventional automobiles: (1) small, lightweight rear engine vehicles, (2) standard full size medium weight automobiles, and (3) a heavy, luxurious type of automobile. Underride guard clearance above the roadway was varied in the tests for which the nominal impact speeds were 40 MPH. Impact loads applied to the rigid underride guard and the dynamic response of the vehicles were recorded, analyzed and evaluated.

The objectives of the tests were to measure both the crash response characteristics of conventional automobiles of various size and weight and the loads imposed on the underride guard in relation to the clearance height of the underride guard above the roadway. The results will provide a technical data base to support formulation of safety standards.

MAJOR CONCLUSIONS

From the data measured in the series of six full-scale tests of vehicles impacting a simulated rigid underride guard, the following conclusions are drawn.

- The maximum underride guard clearance above the roadway that will provide underride protection of full size automobiles impacting at a speed of 40 MPH is 24 inches.
  - In each of two tests, one in which the vehicle was in a simulated braking pitch attitude, the penetration of standard full size automobiles impacting the rigid underride guard positioned 24 inches above the ground was acceptable but approached the maximum that could be tolerated. Increasing the height of the guard would permit both the engine and front wheel and suspension assemblies to underride and, thereby, result in intrusion of the guard into the passenger compartment.
- At a guard height of 18 inches above the roadway, adequate protection against excessive underride will be afforded to full size cars and to some, but not all, of the smaller lightweight types of automobiles.
  - In three tests conducted at a guard height 18 inches with both heavy and medium weight class full size automobiles (Lincoln Continental and Ford) and a small rear engine car (Volkswagen), underride penetration was acceptable in terms of avoiding intrusion of the passenger compartments. However, in a test with another small size rear engine automobile (Simca), the results were disastrous because the vehicle underrode to the extent that the guard violated

the passenger compartment. The differences in the response of the two small automobiles is attributable to: (1) the smaller wheels of the Simca which allowed them to be forced under the guard during the impact so that the high loads usually developed by contact with the relatively strong suspension structures were substantially reduced, and (2) the weaker structure of the Simca compared to the Volkswagen.

- Longitudinal loads imposed on the underride guard increase with the weight of the impacting vehicle. Peak loads of relatively short duration are developed by conventional front engine cars when the engine contacts the underride guard and may be as great as 250,000 to 300,000 lbs in a 40 MPH impact.

    - Measurements of the dynamic loads on the rigid underride guard reveal that the forces in a given crash are highly variable and that the maximum value, which occurs early in the impact and before the passenger compartment velocity has been substantially reduced, may be several times the average load. The possibility of disastrous failure of the guard structure under these high impulsive type loadings requires that they be a consideration in the establishment of underride guard performance criteria.

- Substantial upward vertical forces that increase with increased guard ground clearance are applied to the guard by the underriding vehicle.

    - Peak vertical loads in each of three tests at a guard ground clearance of 18 inches and with automobiles of different weight and size was approximately 17,000 lbs. In another test with a medium weight full size car and with the underride guard raised to 24 inches ground clearance, the maximum vertical load on the guard was 43,000 lbs. Because the underride guard in the tests was constrained to prevent vertical as well as horizontal motion, it is not known whether forces of like magnitude would be developed on an actual truck installation. However, the measurements do suggest that lifting of the truck with an attendant increase in underride penetration is a potential problem.

The opinions, findings and conclusions expressed in this summary are those of the contractor and not necessarily those of the National Highway Traffic Safety Administration.

Availability: NTIS (Formerly Clearinghouse), U. S. Department of Commerce, Springfield, Va. 22151. Order DOT/HS-800 316 in papercopy (HC) or microfiche (MF).

executive summary

A SYNOPSIS OF A RECENTLY RELEASED NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION RESEARCH REPORT

RESEARCH IN IMPACT PROTECTION OF AUTOMOBILE OCCUPANTS

The purpose for this program was to develop rational and substantial performance requirements for automobile interiors in order to improve occupant protection in collisions.

Contract No. FH-11-6955 (Part I)
Cornell Aeronautical Laboratory, Inc.
4455 Genesee Street,
Buffalo, New York 14221
DOT/HS-800 319

Award Amount:	$371,504.00
Date Report Due:	6/30/70
Date Report Rec'd:	9/24/70
Release Date:	12/3/70
CAL No. VJ-2672-V-1	

THE PROGRAM

A research program was conducted with the objective of establishing a factual basis for future performance requirements for vehicle interiors. Actual highway accidents, from the Automotive Crash Injury Research file, were reviewed in detail from a statistical viewpoint to establish interior target areas for given components of the human body and to rank the injury severities produced by the contacts. Engineering analyses, utilizing a computer simulation of the crash victim and experiments with an accelerator sled, were performed to supplement the statistical data and to determine the energy absorption and load deflection requirements for the various impact areas.

The problem of providing improved collision protection for automobile occupants was complicated by the currently limited utilization of restraint systems; by the ranges of occupant sizes, weights and conditions; and by the wide variety of collision conditions. While efforts are still being applied toward the development of improved restraint systems and also toward public education regarding the use of existing restraints, the problem of providing the maximum possible protection for lap-belted and unrestrained occupants continues to be an important one.

Those areas of motor vehicle interiors most frequently impacted by occupants and which are covered by Motor Vehicle Safety Standard 201 were also examined in order to determine the efficacy of that standard.

A further objective of the research program was to develop performance requirements for the various interior components. To this end, analytical studies and experiments were performed and human tolerance limits examined.

MAJOR FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Statistical Study

From the statistical study of occupant contacts with automobile interiors, it was concluded:

- The methods developed for, and applied in, the study provided a means of identifying and recording contact points with reasonable accuracy. It made possible the correlation of injury information with data on the interior components involved. Finally, it provided for successful ranking of vehicle interior components in alternative manners, in order to help establish priorities for improvement of vehicle interior safety.

    - On the other hand, the statistical approach had its limitations. The small sample size, dictated by economics involved, forced a collapse of the data with regard to many important modifying variables, resulting in the confounding or masking of many effects which can be postulated to be present. For example, it was not possible to demonstrate statistically the effects on

contact patterns of car size or occupant size, although such effects are known to exist. In other respects, too, the presence of substantial variation—not necessarily random in nature—made it difficult to discover some of the finer contact pattern effects which have to do with the configuration of the crash, vehicle design and physical characteristics of the occupants.

- These statistical difficulties, emanating from the small size of a heterogeneous sample, did not prevent the study from reaching its principal goals. The basic concept patterns, in terms of their geographic distribution, the components involved and the resulting injuries are so consistent and so clear that they emerge quite satisfactorily in the present study. In view of this fact, it must be concluded that the study did achieve the basic objectives.

- Since Motor Vehicle Safety Standard 201 is effective on 1968 and newer model cars only, no evaluation of the benefits of compliance with the standard could be made in this research program. However, examination of those contacts on vehicle interior areas for which Standard 201 specifies performance requirements showed that these impacts constitute only 7.8% of the total number of injury producing contacts reviewed in this study. It should be noted that the locations of approximately 20% of the total of injury producing contacts could not be identified with confidence. However, it is considered to be unlikely that a major portion of those contacts were within the Motor Vehicle Safety Standard areas.

Engineering Studies

- It is considered to be entirely feasible to provide protection against lethal injuries for most unrestrained and lap-belted occupants in frontal collisions with impact speed changes up to 22 MPH with the possible exception of direct impacts on the "A" and "B" pillars.

  - For other components of the vehicle interior, it appears that protection levels that are compatible with each other and which would correspond to a 22 MPH frontal impact can be incorporated without excessive difficulty. Specific recommendations for performance requirements are presented in Section 5.0 of the report.

- Simple techniques of dimensional analysis can yield reasonably accurate approximations of the locations of occupant-interior contacts that occur in actual accident cases, at least for those cases in which the effects of angular accelerations of the vehicle can be neglected.

  - The validity of impact point predictions on the basis of simple dimensional analyses was demonstrated in comparisons with closely matched cases (i.e., groupings that pool certain variables in order to achieve a larger sample size), a substantial amount of "scatter" in the actual accident data is believed to be due to effects of pitch, yaw and roll accelerations that occur in actual collisions but which are neglected in the simplified dimensional analyses, as well as in the reported sled tests and in the existing form of the CAL computer simulation.

- Existing forms of impact sleds, in which the vehicle is constrained to linear motions, may not adequately simulate actual collisions.

  - The extensive scatter in the contact points obtained from ACIR data indicates that the angular accelerations that occur in actual accidents may exert an important influence on occupant kinematics relative to the vehicle interior. None of the currently available acceleration sleds include provisions for the simulation of such effects.

- Directional properties of energy absorbing steering columns tend to render them ineffective in oblique collisions.

  - In the limited number of 30 MPH oblique impact sled runs (simulating ±30 degree oblique impacts) that were performed within the present research program, the energy absorbing steering column was not activated by the lap-belted dummy in the driver position.

- Existing anthropometric dummies may not adequately simulate the behavior of lap-belted humans. Slippage of the lap belt off the pelvic structures of dummies frequently occurs, and the resulting kinematics correspond to restraint at the abdominal region.

Recommendations

Statistical Study

- The initial success of the statistical study, notwithstanding its inherent limitations, suggests strongly that this type of approach be applied again in the future for evaluation of the effects of safety standards for the vehicle interior. There will be an obvious need for such evaluation as vehicle design and safety standards are developed and introduced in the course of time.

- An effective application of statistical methods requires, however, that lessons learned from this initial attempt be observed and that corrective action be taken where feasible. Some pertinent recommendations follow.

  - Larger sample sizes are desirable if many variables, such as vehicle size, occupant size, exact crash configuration, relevant velocities, etc., are to be accounted for simultaneously.

  - Data collection should be specifically planned for the purposes of contact point analysis. The ACIR data used in this instance had not been collected with this specific objective in mind, and the troopers submitting the crash reports often failed to call attention to details of interior contacts.

  - Whether the crash investigators for this kind of a program should be police officers or specialized and professional accident investigators is a matter to be determined on the basis of feasibility and convenience and also of economy. We recommend, as the preferred procedure, use of professional investigators who can apply much more time and care to an investigation than can the police who is burdened with many additional duties at the accident scene.

  - In either instance, a contact-point analysis-oriented training program is recommended for the investigators. It is felt that such a training program would be particularly valuable if a contact point analysis is to be extended to include collisions other than single impacts to the front or side of the vehicle.

  - A valuable ingredient in such a program would be a manual, prepared on the basis of results of the present study and including both numerous contact point plots and well selected examples of specific difficulties in the identification of actual contacts.

  - Similarly, emphasis on good interior photography is recommended as a vital part of such training.

  - As a technical detail, we recommend that appropriately scaled plotting diagrams of different sizes be used for the major size groups of cars, instead of adapting all plots to fit one standard grid.

Engineering Studies

- A program of experiments should be performed to demonstrate both the benefits and the feasibility of the performance requirements recommended herein.

- A three-dimensional computer simulation of the crash victims should be developed to extend existing analytical capabilities in relation to occupant protection. The present study has demonstrated the utility of computer simulation for exploration of the requirements for energy absorption and load- deflection properties for a wide variety of occupant sizes, conditions of restraint and exposures. An extension to three dimensions would, of course, permit the performance of more comprehensive studies.

- The feasibility of developing an accelerator sled that includes adjustable angular accelerations should be investigated. With such a device, the detailed responses of vehicles in staged collisions could be reproduced and repeated in sled experiments.

- The adequacy of existing anthropometric dummies, for use with automobile type restraints, should be critically reviewed. Particular attention should be given to the problem of lap belt slippage of the pelvic structure.

- Means should be investigated to reduce the directional sensitivity of energy absorbing steering columns with a view toward increasing their effectiveness in oblique collisions.

- Investigation should be undertaken of the feasibility of a compliance test technique which would not require interpretation of acceleration time histories. A mechanical model might be devised which fails in the same way as the body part under consideration. The compliance test could then be a simple "pass" or "fail" one.

The opinions, findings, and conclusions expressed in this summary are those of the contractor and not necessarily those of NHTSA.

Availability: NTIS (formerly Clearinghouse - CFSTI), U. S. Department of Commerce, Springfield, Va. 22151. In papercopy (HC) or microfiche(MF), order DOT/HS-800 319 or PB-195 803.

executive summary

YNOPSIS OF A RECENTLY RELEASED NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION RESEARCH REPORT

MULTIDISCIPLINARY ACCIDENT INVESTIGATION

The purpose of this program is to collect and evaluate data on the relationship between human, vehicle, and environmental factors and traffic crashes, and to develop systematic multidisciplinary techniques and procedures for study of traffic injuries and fatalities in relation to these relevant factors.

Contract No. FH-11-7219
Southwest Research Institute
8500 Culebra Road
San Antonio, Texas 78228
DOT/HS-800 320

Award Amount:	$87,528.00
Date Report Due:	6/30/70
Date Report Rec'd:	11/25/70
Release Date:	12/3/70

GENERAL PURPOSE

In-depth accident investigations, performed by multidisciplinary teams of professional researchers and trained investigators, assume a significant role in highway safety research by providing responsible public officials and citizens with the best available description of accident causes and injury producing elements. The data generated from these investigations by teams throughout the country are being quantified and collected in a data file by the National Highway Traffic Safety Administration in Washington, D.C. The results will be analyzed and countermeasures evolved to reduce the tremendous annual toll in life, injury, and expense resulting from these highway tragedies.

Objectives

Southwest Research Institute was awarded a contract to establish a team in Bexar County, Texas, and undertake the investigation of 30 accident cases. The objectives of the program were:

- Identify pertinent factors which contribute to or cause the occurrence of a motor vehicle accident.
- Identify injury-causative factors.
- Evaluate the effectiveness of countermeasures, particularly those outlined in the motor vehicle safety standards.
- Provide early detection of design and functional problems of the vehicle and the highway.

Organization

The goals of each of the 16 investigating teams are essentially similar. Although the teams operate independently of one another, coordination through the sponsoring agency was initiated to establish minimum investigate standards. This coordinating effort insures that comparable results are received from each of the teams.

At the outset of the SwRI program, team members attended training programs to learn investigative techniques and to discuss what facets of the accident problem were of most concern to the National Highway Traffic Safety Administration and to other Federal and industrial users. Two conferences (or seminars) were held: one at UCLA, organized by the Trauma Research Group, and the other at Airlie House, Virginia, organized by the Cornell Aeronautical Laboratory. With the background obtained at these meetings, the Southwest Research Institute team was organized with the overall program management supervised by an engineer. Investigating team members include engineers, psychologists, physicians, and other consultants, as necessary for each specific case. For example, autopsy data in fatal cases is supplied by the Medical Examiner. Also, expert analysis of special problems is available from any member of the SwRI staff.

Prior to commencing a program as comprehensive as the multi-disciplinary accident investigations, the cooperation and support of numerous agencies and organizations in the community were sought and obtained. Perhaps the greatest program benefits have been derived as a result of the help and assistance received from local law enforcement agencies, i.e., the San Antonio Police Department, the Bexar County Sheriff's Department, and the Texas Highway Patrol. Other agencies which provide support for the SwRI studies are the County hospital district, the County Medical Society, the University of Texas Medical School in San Antonio, the Texas Highway Department, the Ft. Sam Houston Military Police, the Lackland AFB Air Police and Officer Training School, the Brooke Army Medical Center, the Wilford Hall USAF Medical Center, local credit associations, local radio, television, and news media, and, not least important, the general public.

Good relations with these and other organizations and individuals are maintained on a continuing basis and the results obtained from the accident studies are fed back into the local system where immediate positive corrective action can be taken. In addition, SwRI has established communication links with the Governor's Traffic Safety Administrator and with members of the Texas Congress. As the program matures and the studies achieve greater recognition, their potential value will increase at all user levels. New users must, therefore, be urged to study and utilize the results and recommendations of the teams and, when appropriate or applicable, institute the necessary changes to make the highways safer.

Accident Criteria

An attempt has been made to select accidents for in-depth study on as random a basis as possible. According to the requirements of the contract, an accident must satisfy the following criteria to be considered for investigation: it must be an accident involving a fatality or serious injury, or at least one of the vehicles must be damaged seriously enough to be towed away from the accident scene by a wrecker. In addition, at least one of the vehicles involved in the collision must have been manufactured in the last three model years. Occasionally, these criteria are overridden when the accident situation involves certain interesting features such as fatality or serious injury resulting from an unusual situation or extremely hazardous environmental or vehicular conditions. In the current study, two of the cases were special, as discussed later. The field investigators have been briefed not to select only the sensational or spectacular types of accidents to the exclusion of all others that would satisfy the above criteria.

Investigation Procedures

The investigation team is notified by the police agency that a major or "unknown" accident has occurred. A major accident, as normally reported, is usually a high energy crash, one that often involves personal injury. An "unknown" accident is one in which the severity is unknown to the police dispatchers. These types of accidents are distinguished from the minor accidents, i.e., those accidents which fall loosely under the category of "fender benders." Notification of the accident is received from the Police dispatcher who calls on a special phone at the team headquarters at Southwest Research Institute or by mobile phone installed in the truck. Occasionally, notification is received by one of two VHF police radio monitors installed either in the Travelall or in the headquarters office. Less frequently, the team will run up on an accident as they cruise the city streets and freeways.

An investigating team is usually composed of two or three people. Upon arrival at the accident site, the investigators determine whether their assistance is needed in either first aid or traffic control. Two of the SwRI team members are certified in Red Cross First Aid and in Emergency Medical Rescue Service. At the scene, the team gathers the transient data as expeditiously as possible. Since one of the principal objectives of the police investigators is to restore traffic to its original flow, it is seldom possible for investigators to do more than obtain scene photographs and measurements, and to locate the postcrash positions of the vehicles. When possible, brief interviews are obtained with the car occupants and witnesses. Permanent highway characteristics and measurements and vehicle deformation data are acquired at a subsequent more convenient time; for example, when traffic is light or when the vehicle can be raised and inspected without endangering the crowds of investigators.

Background data on the drivers are collected from driving records, credit records, school records, and other sources, and a copy of the police accident report is required. Psychological interviews are undertaken with cooperating victims (or families in the case of fatalities). When warranted, more general questions are

asked of the driver's acquaintances, employers, and witnesses to the accident. Medical data describing the anatomical location of the injuries and relative injury severity are requested from the occupant and his attending physician. Often, such data are extracted from emergency room medical records. When all of the information has been amassed, preliminary reconstruction of the vehicle dynamics is undertaken and the collision scene schematic drawn. The engineering and medical disciplines compare anatomical injuries of the occupant with the vehicle interior damage and reconstruct the occupant kinematics. The vehicle and highway characteristics are evaluated for possible defects and hazards as well as for positive factors. Particular attention is devoted to evaluating the effect of the motor vehicle safety standards. Psychological factors are weighed in consideration of the physical evidence uncovered by the other team members. Prior to preparation of the final case report, the case is reviewed with the color slides and informal discussion sessions conducted between disciplines. Causal factors, findings, recommendations, and positive factors are identified in relation to the nine-cell highway collision matrix as the final phase of each complete case investigation.

MAJOR FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations set forth by Southwest Research Institute at the completion of the first phase of their program are derived from the findings in 30 accident cases involving 50 automobiles and trucks. Obviously, the statistical significance of such a small sample is minimal; however, when these data are analyzed with those of the other investigating teams, very important patterns in regard to accident and injury causation should become apparent.

There are also short-term, small-scale benefits derived from these multidisciplinary accident investigation studies. Numerous specific and general findings have been identified which have immediate application at local and State levels. These findings, if effectively incorporated into the transportation network, could bring about marked reductions in local accidents and accident severity.

A basic, though not surprising, observation is that a majority of the elements surrounding an accident are in the area of human factors. The study also recognized the needs for improvements in vehicular and environmental factors. But perhaps the greatest achievements toward the mitigation or elimination of highway crashes will result when positive measures are devised to counteract and correct many of the observed human defects.

The following items were observed in one or more of the 30 case studies. The conclusions and recommendations are based on the results of individual case studies; there is no claim for statistical significance in these data as they stand alone. However, their justification is that they represent an in-depth analysis of a motor vehicle accident by a multidisciplinary team of specialists trained academically and in the field in the techniques of accident investigation.

Driver Education Program

- Numerous human behavioral and emotional defects have been observed as causative factors in the SwRI study. Driver education programs should be implemented that stress the need for drivers to become aware of these defects and hazards such conditions represent to the driving public. Driver training programs should include instruction in basic behavioral and emotional facts surrounding the role one plays in society as a driver. Driver trainees should be taught the role emotions play in safe driving. Too much emphasis is placed on improving driving techniques and too little on improving driving attitude. Programs should be implemented which stress the need for responsible behavior while driving. Particular emphasis should be placed on the detrimental effects of alcohol on driving ability. These behavioral awareness and alcohol danger programs should be introduced to young children as part of their formal education.

- Drivers must be taught how to identify these ability degrading psychological effects in themselves and be willing to undertake remedial measures. Programs of remedial instructions should be educational and instructive rather than punitive in presentation. These programs should emphasize the positive personality factors of those who operate automobiles and less emphasis should be placed on the detrimental components surrounding the defects.

- It is recommended that driver education programs be mandatory for all drivers. Driver reeducation programs and programs with therapeutic significance should be required for drivers whose underlying personality

structure seems to indicate the need. Special tutoring should be available for exceptional drivers.

- Followup reeducation programs should be considered for commercial employees who exhibit poor driving records. This reeducation program should be the responsibility of the employee. In all driver education programs, greater stress must be placed on learning good defensive driving techniques.

- According to the results of the SwRI study, the driver education programs should incorporate the following:

  ◦ Emphasize the effect of sleep loss and fatigue on the driving task.

    The predominant effects of sleep loss and fatigue on the driving task are brief lapses of attention which occur with increasing frequency, and some less measurable but important decrements in judgement and the ability to detect and evaluate potential accident situations. Impairment in some more obvious components of driving (reaction time, tracking performance, signal detection) are usually small and are measured largely as increased variability in performance with minimal changes in mean values. This latter aspect; however, is not to be viewed complacently; it leads the driver to believe he is still performing at normal levels, because he is not good at evaluating his own brief lapses in attention or his losses in judgement.

  • Emphasize the effect of the excessive use of alcohol both during the intake and recovery periods.

  • Discuss the effect of social and/or driving excesses.

  ◦ Examine the hazards of impulsive exhibitionistic driving.

  • Recognize the role of masculine drives and shift the emphasis from "speed can kill" to that of skill combined with appropriate driving behavior.

  ◦ Investigate the effect of mild multiple stresses.

  ◦ Emphasize the hazards associated with the tendency for increased risk-taking behavior resulting from time pressures.

  • Discuss the hazards of inflexible driving routines.

  ◦ Recognize the need to react to unexpected hazards.

  • Recognize the role of emotions in regard to driving task.

Poor-Risk Drivers

- A significant portion of the drivers of accident vehicles were observed to have poor driving records and numerous traffic accidents. Such drivers should have their driving privileges suspended until a therapeutic reeducation program has been successfully completed. More thorough screening of these habitual violators by licensing agencies is imperative and stricter enforcement of suspended and/or revoked licenses is needed.

Public Information

- Public information programs are recommended as an effective means of transmitting safety messages. Such programs would be designed to augment, not replace, the driver training program. It is the opinion of SwRI investigators that a large percentage of the population (both drivers and nondrivers, is uninformed of certain seemingly obvious safety practices, e.g., proper use of acceleration and deceleration ramps on freeways; intent and understanding of roadside signs and pavement markings; the need to keep a safe distance at accident sites due to danger from fire and other hazards; awareness of overconfidence in one's abilities; and the hazards of certain environmental conditions (such as precipitation right after the roads first become damp or pools of water in the highway). These are but a few examples of topics which should be covered in such a program.

Use of Alcohol

- Quite often, a police investigator will record on the accident report that a driver is under the influence of alcohol or drugs and/or that he had been drinking. Nevertheless, no action is taken concerning this person. He is not requested to submit to a breathalyzer test and

he is either released or sent to the hospital for treatment. The apathy displayed by police officers toward suspected intoxicated drivers results largely from the lack of public and judicial support. When the person is charged wih Driving While Intoxicated, and brought to court, it seems to be extremely difficult to obtain a conviction. The fault may not rest entirely with the magistrates, however, since it is known that many of the "intoxicated driver" cases are tried before a jury and the judicial rulings are constrained by the jury's findings.

There is a great need for the public to recognize the threat presented by the intoxicated driver. Immediate steps must be taken to eliminate this threat either through a rehabilitation program or exclusion of such persons from the driving population.

Common Accident Causes

- Several of the more significant accident causative and contributive factors in the SwRI study were excess speed, inattentiveness to the driving task, mild to severe alcohol impairment, and fatigue. Tire problems also were identified frequently, as was the existence of posts and other structures too close to the roadway.

Emergency Medical Service

- Emergency Medical Service was observed to be poor in several accident investigation cases, although there is currently a drive in San Antonio to certify ambulance attendants. The Texas Public Health Department, in cooperation with local medical societies, conducts four-day Emergency Medical Service Symposia periodically in locations throughout the state. Attendance, testing, and certification of all ambulance drivers and attendants at such symposia should be mandatory.

Side-Impact Protection

- Passenger protection against lateral impact where occupant compartment intrusion occurs were poor. Where intrusion was adjacent to the occupant, the use of lap and upper torso restraints provided marginal protection, insuring only that the occupant was not ejected. Stronger side structures and better interior padding and protection are needed.

Motor Vehicle Inspection

- Numerous vehicle defects were observed in the study, ranging in severity from minor to serious. The defects alluded to here are those correctable through proper maintenance and vehicle inspection, e.g.. general mechanical condition of the vehicle, exhaust system integrity, brake shoe and brake drum wear, etc. Some parts of the State Motor Vehicle Inspection laws are weak, as for example, the lack of inspection of brake shoes. On the other hand, some of the State licensed motor vehicle inspections stations are not conscientious in filling the requirements of the existing State MVI statutes. Stronger, more definite laws and stricter enforcement and interpretation of existing regulations are needed to minimize the contribution of such vehicular defects.

Roadside Obstructions

- Posts, poles, light standards, etc., placed too close to traveled roads caused numerous injuries when vehicles collided with them. Post placement should be reviewed for all existing and new roads, and, where warranted, one of three countermeasures taken: (1) relocate the post a greater distance from the road edge; (2) construct a guardrail protective barrier; and (3) replace solid post bases with frangible, shear, or slip-type bases.

The Contract Manager has certified that the contractor's work has been satisfactorily completed and that all contractual obligations have been met.

The opinions, findings, and conclusions expressed in this summary are those of the contractor and not necessarily those of NHTSA.

Availability: NTIS (formerly Clearinghouse CFSTI), U. S. Department of Commerce, Springfield, Va. 22151. Order DOT/HS-800 320 or PB-195 320 in papercopy(HC) or microfiche (MF).

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